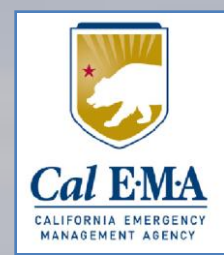
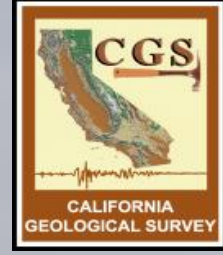


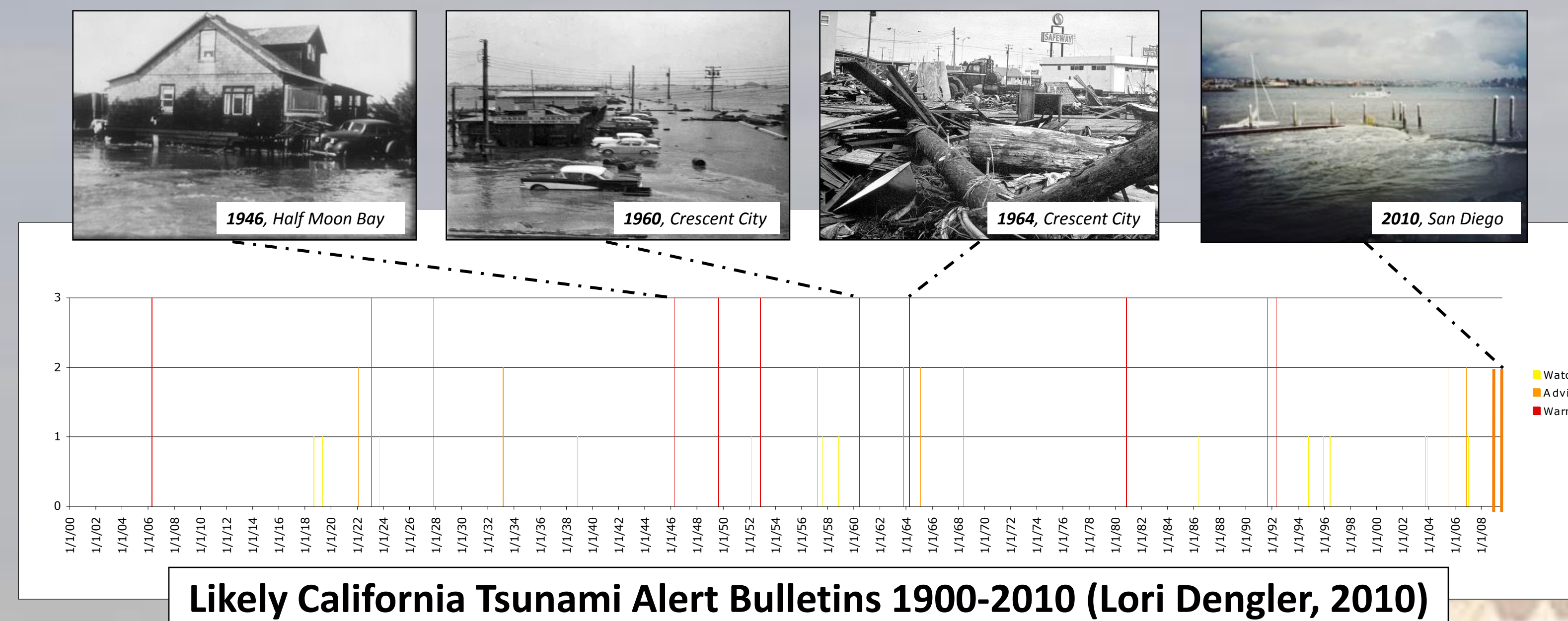
CALIFORNIA'S PRE- AND POST-TSUNAMI FIELD OBSERVATION TEAM AND CLEARINGHOUSE



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ABSTRACT: For tsunamis caused by distant earthquake sources, which have occurred on average about every five years over the past 70 years, there is a delay of four to fourteen hours between the time the tsunami is generated and when it arrives along California's coast. This delay provides an opportunity for California Geological Survey (CGS) field teams to be deployed. These field teams are similar to other states' "tsunami observer" programs but comprised of trained geoscientists deployed to predetermined, safe locations to observe tsunamis in real-time and gather perishable field data (current speed estimates, inundation amounts, sediment/debris deposits, infrastructure damage, etc.) immediately after the events occur. Real-time field observations will be transmitted to a "clearinghouse" of regional and centralized state scientists and emergency managers, which will help determine state-level emergency response actions and the threat to other portions of the coast where the tsunami has not yet arrived. In addition, program members will be encouraged to foster working relationships with local emergency managers (cities, counties, ports, military, parks, etc.) through existing regional tsunami "work groups." As the need arises, members can readily provide these emergency managers on-site advice prior to, during, and after the arrival of tsunamis. Established by funding through the National Tsunami Hazard Mitigation Program, collection of this field data will: 1) greatly enhance our understanding of tsunami hazards, 2) provide a mechanism for collecting information about smaller, less damaging tsunamis when other established field teams (EERI, NSF, etc.) are not deployed (as during the February 2010 Chile Tsunami Advisory in California), and 3) could help in validating numerical tsunami modeling for NOAA and the state. For larger tsunami events, the CGS Tsunami Clearinghouse will work closely with the well-established California Earthquake Clearinghouse, of which CGS is also a core member, to help coordinate post-tsunami field teams within the state.



Likely California Tsunami Alert Bulletins 1900-2010 (Lori Dengler, 2010)

Tsunami Watch - issued to alert emergency managers and the public of an event which may later impact the watch area; may be upgraded to a warning or advisory - or canceled - based on updated information/analysis.

Tsunami Advisory - issued due to the threat of a potential tsunami which may produce strong currents or waves dangerous to those in or near the water (typically tsunami forecast amplitudes 30 cm to 1 m). Over past 110 years, there would have been 8 from distant sources and 2 from local tsunami sources.

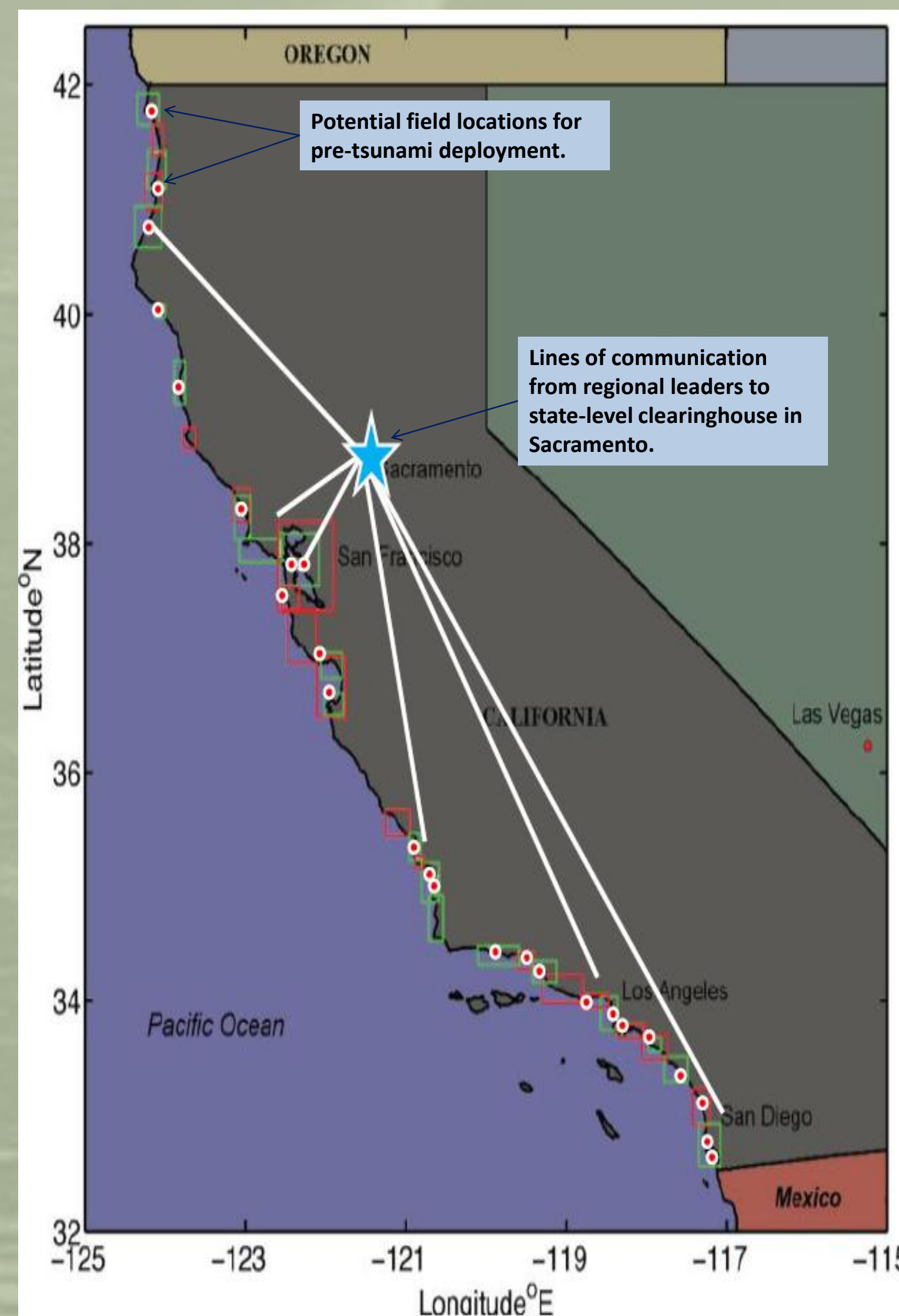
Tsunami Warning - issued when a potential tsunami with significant widespread inundation is imminent or expected (typically tsunami forecast amplitudes over 1 m). Over past 110 years, there would have been 4 from distant sources and 7 from local tsunami sources.

An evaluation of historical tsunamis over the past 110 years (figure to the left) demonstrates that tsunamis from distant sources have occurred frequently. In the past two years, there have been two tsunami Advisories issued for the California coast. On September 29, 2009, a M8.2 earthquake near the Samoan Islands generated a tsunami that caused one to two foot surges and moderate currents within harbors and bays (Wilson et al, in press). On February 27, 2010, the M8.8 Chilean Earthquake produced a tsunami that created three to four foot surges and strong currents that caused damage within at least ten harbors totaling several million dollars statewide (Wilson et al, 2010).

Data collected by field personnel and instrumentation for tsunami events like these and larger are important for tsunami forecast scientists, state tsunami modelers, and emergency managers. During these last two events, earth scientists from the California Geological Survey (CGS), U.S. Geological Survey, academia, and private industry independently collected field data at several locations. After the February 2010 tsunami, CGS and the California Emergency Management Agency sent questionnaires and interviewed coastal emergency personnel and harbor masters to determine the extent of damage. This task, while informative, was labor intensive and it is believed that much of the specific data related to damage was not accurately cataloged. For this reason, CGS is developing a pre- and post-tsunami field team of 30 to 40 members to collect this data more quickly and efficiently during and after a tsunami. The specific activities of this field team and its members are described below.

Pre-Tsunami Activities:

- Establish regional state/federal science personnel contacts for local government officials, enhancing development of regional tsunami "working groups."
- Provide on-site assistance to local emergency planners and responders on the expected size and duration of the tsunami, if this information is requested.
- Prior to arrival of Advisory or Warning level tsunami, deploy field team members and initiate tsunami observation plan, including: 1) flow-depth and flow-velocity instrumentation, 2) long-recording video equipment installation, and 3) safe tsunami observation location.



Actions During Tsunami:

- Make observations about the size, duration, velocity, and impact of tsunamis in real-time.
- Provide feedback from regions to state-level "clearinghouse" and supply backup communications pathway for emergency information to get to local government officials.



Feb. 27, 2010 - Tsunami flow depth measurements being taken by Mark Legg at the mouth of the Santa Ana River).



Feb. 28, 2010 - Inundation in Sunset Beach area from both storm and tsunami activity 24-hours after first arrival of Feb. 27, 2010 tsunami in California.

Post-Tsunami Activities:

- Assist local emergency planners with short-term recovery planning.
- Collect detailed information about tsunami damage and perishable field evidence, such as run-up heights/distances, sand deposits and debris movement.
- For large events, coordinate field activities with other field teams established through the California Earthquake Clearinghouse, EERI, NSF, etc.
- Document event in a consistent GIS format and final report so information is readily available to NOAA and other scientists and emergency managers.



Damage to docks in Ventura Harbor from Feb. 2010 tsunami

For more information about this project and other tsunami hazard mapping projects in California, please visit: www.tsunami.ca.gov.

Photos by Rick Wilson, Mark Legg, Dale Carnathan, Orville Magoon, Howard Anderson, and Robert Wiegel.

References:
Wilson, R.I., Dengler, L.A., Legg, M.R., Long, K., and Miller, K.M., 2010, The 2010 Chilean Tsunami on the California Coastline: Seismological Research Letters, 81(3), pp. 545-546.

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